

Question 1 (11 marks)

Question 1a (1 mark)

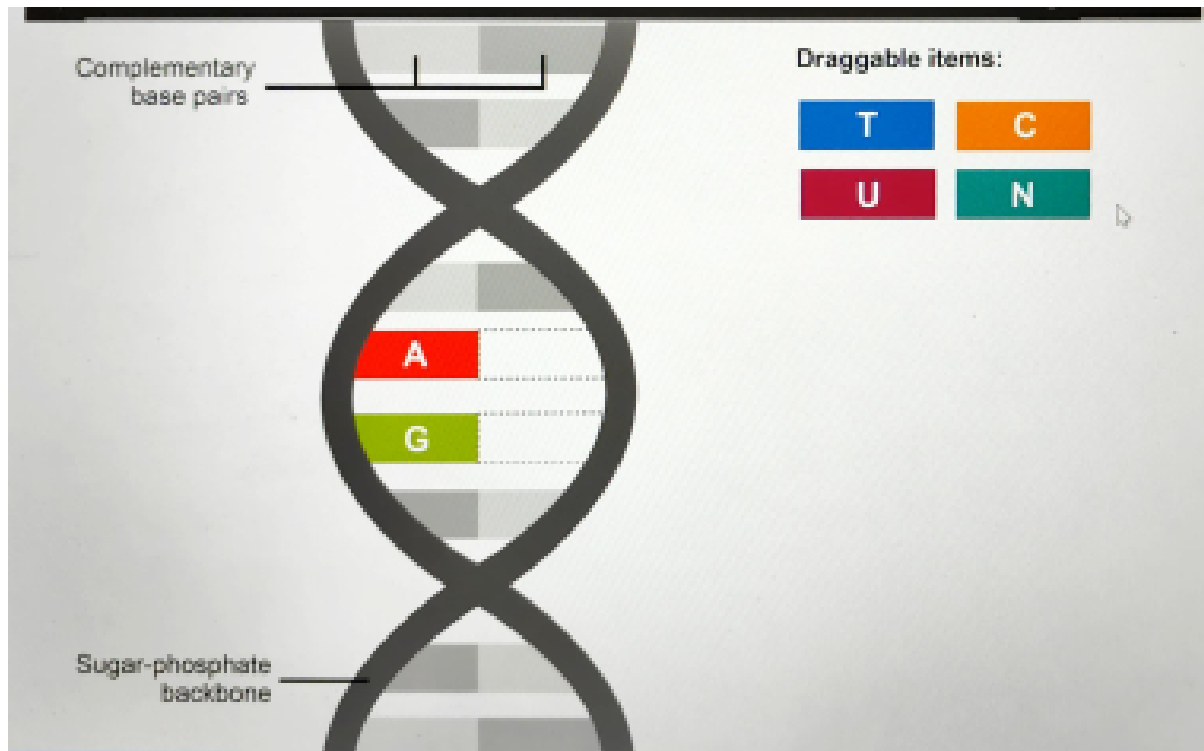
State the cell organelle where an animal's DNA is found.

B **I** **←** **→** **U** **X** **✓** **≡** **≡** **Ω** **Σ** Styles **+**

Question 1b (2 marks)

DNA, deoxyribonucleic acid, consists of two sugar-phosphate backbones held together by complementary base pairs, as shown in the diagram.

Select and drag the correct complementary bases to complete the molecule.



Question 1c (1 mark)

Cystic fibrosis is an inherited disease caused by a defective recessive allele affecting the lungs and digestive system. It can be passed on to children if the mother and father both have a copy of the defective recessive allele, *a*.

Select the meaning of the term allele.

Alleles are bacteria that cause disease.

Alleles are different forms of the same gene.

Alleles are proteins found in cells.

Alleles are traits seen in organisms.

Question 1e (1 mark)



Question 1d (1 mark)

Use the symbols *A* and *a* to complete the table below.

		Father	
		<i>A</i>	<i>a</i>
Mother	<i>A</i>		
	<i>a</i>		



Question 1e (1 mark)

Determine the probability that a child does not have the disease but is able to pass it on.

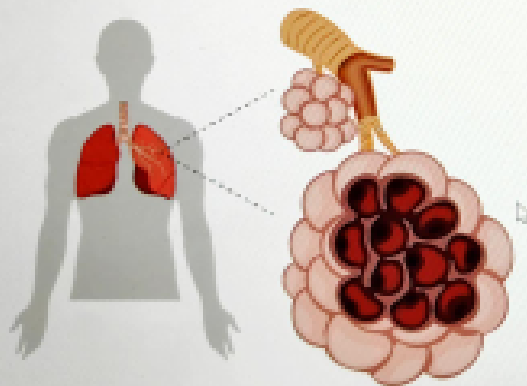
Rich text editor interface with a toolbar containing icons for bold, italic, text color, background color, bulleted list, numbered list, link, unlink, and insert link. Below the toolbar is a text input area.



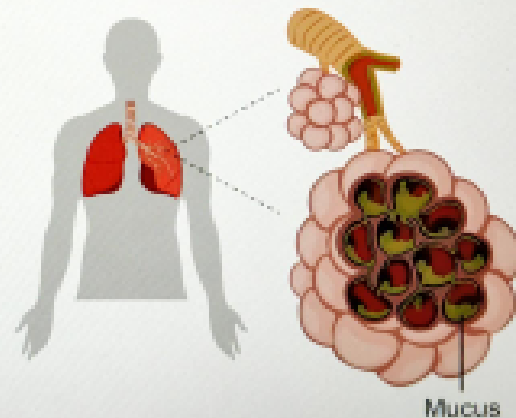
Question 1f (2 marks)

One of the symptoms of cystic fibrosis is the production of thick and sticky mucus. The images show a cross-section of healthy alveoli and alveoli of a person with cystic fibrosis.

Healthy person



Person with cystic fibrosis



Outline how the structure of the alveoli supports gas exchange.



Question 1g (1 mark)

Suggest one symptom caused by mucus collecting in the alveoli for people with cystic fibrosis.

B *I* ← → U ~~X~~ ~~X'~~ \int \sum Ω Σ Styles -

I



Question 1h (2 marks)

Cystic fibrosis is caused by a defective recessive allele. Gene editing technologies like CRISPR allow us to identify and repair defective alleles by cutting out and replacing sections of DNA.

Outline one benefit and one ethical consideration of gene editing.

B *I* ← → U ~~X~~ ~~X'~~ \int \sum Ω Σ Styles -

I

Question 2 (11 marks)

Question 2a (1 mark)

Select the image showing the nervous system.



Question 2b (1 mark)

Select the process which is **not** controlled by the nervous system.

- Breathing
- Mitosis
- Muscle contractions
- Sight

Question 2c (1 mark)

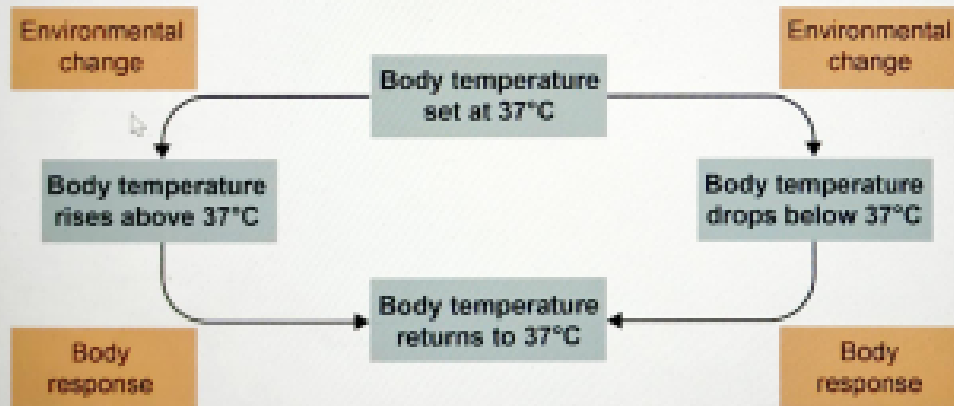
The nervous system is involved in homeostasis. **State** the meaning of the term *homeostasis*.

Rich text editor toolbar with icons for bold, italic, text color, background color, bulleted list, numbered list, link, unlink, undo, redo, and a style dropdown menu. A tooltip labeled "Subscript" is visible over the subscript icon.



Question 2f (1 mark)

The diagram below shows how negative feedback maintains body temperature at a set value.



State one other example of negative feedback in the body.

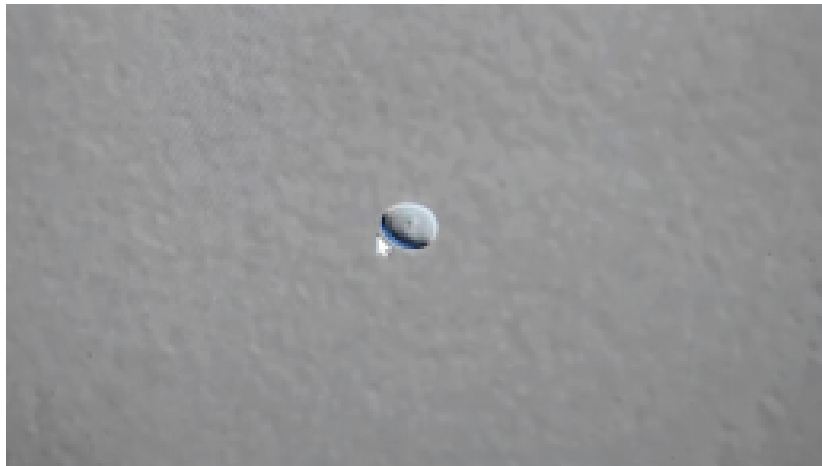


Question 3 (15 marks)



Question 3a (1 mark)

Yeast is a unicellular organism that is often used for laboratory experiments. It is often used as a cell model for testing the impact of environmental factors on living organisms. A yeast cell is a eukaryotic cell that carries out functions of life. A characteristic of all living organisms is shown by the yeast cell in the video below.



Identify the characteristic of living organisms shown in the video.

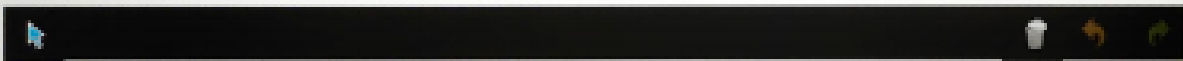
B *I* ← → **U** **X** **Y** **Z** **Ω** **Σ** Styles **+**

I



Question 3b (1 mark)

Another characteristic of living organisms is respiration. **Select** the correct location for each of the terms in the word equation for aerobic respiration.



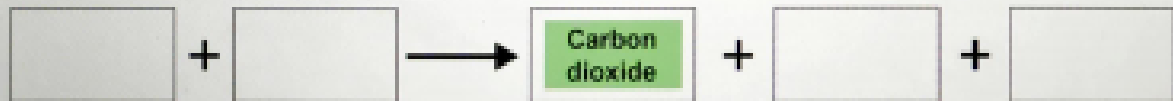
Draggable Items:

Energy

Oxygen

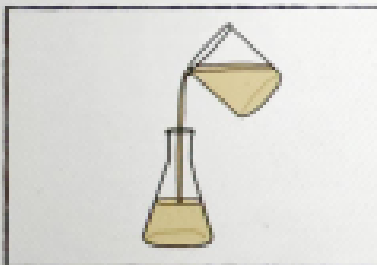
Sugar

Water

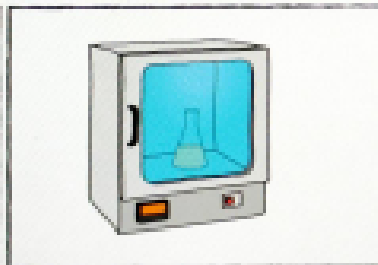


Question 3c (4 marks)

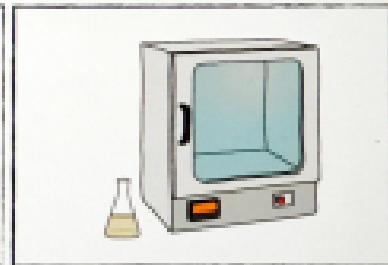
A student wanted to study the effect of ultraviolet (UV) radiation on the rate of respiration of yeast. She planned the method below to investigate how exposure time affects the production of CO_2 .



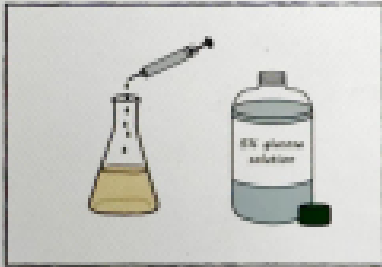
Step 1:
Place the yeast mixture into a flask.



Step 2:
Expose yeast mixture to UV radiation by placing it in a UV chamber.

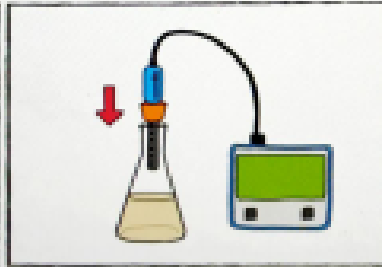


Step 3:
Remove the yeast mixture after a certain time.

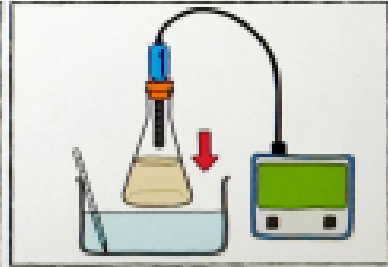


Step 4:
Add 10 cm³ of 5% glucose solution to the flask.

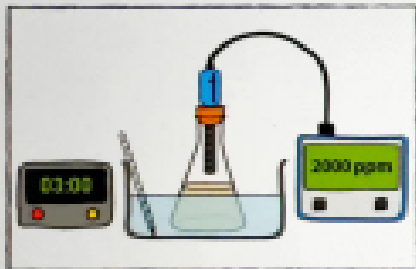
Scroll down to continue



Step 5:
Seal the flask with a rubber stopper and a sensor to measure CO₂ concentration in ppm.

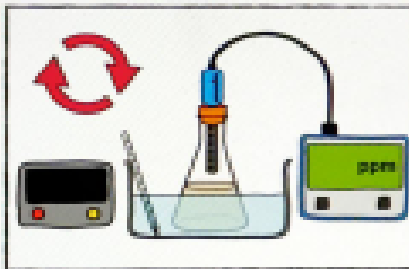


Step 6:
Place the flask in a water bath at 37°C.



Step 7:
Record the concentration of CO₂ after 3 minutes, using the sensor and data logger.

In ppm.



Step 8:
Repeat the method for the next exposure time, using a fresh yeast mixture every time.

Identify the variables in this investigation.



Question 3d (3 marks)

Formulate a hypothesis for this investigation.

If

B *I* ← → U \times \div \int \sum Ω Σ Styles



Question 3e (1 mark)

State the reason for using a water bath in the method above.

B *I* ← → U \times \div \int \sum Ω Σ Styles



Question 3f (4 marks)

Suggest two weaknesses of the investigation and justify your answers.

Weakness 1 and justification

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Styles

Weakness 2 and justification

B *I* ← → U \times \div \int \sum Ω Σ

Styles



Question 3g (1 mark)

At the start of the investigation, the student measured the CO_2 concentration produced by yeast that had not been exposed to UV radiation. **State** a reason for including an experiment using yeast that had not been exposed to UV radiation.

B I ← → **U** \times \div $\sqrt{\quad}$ $\frac{\square}{\square}$ \int Σ Styles - **+**



Question 4 (20 marks)

Students in the biology class carried out the investigation in Question 3 and collected their results in the table below:

Exposure time to UV radiation / minutes	Concentration of CO_2 after 3 minutes / ppm			
	Student 1	Student 2	Student 3	Student 4
0	2201	2499	2397	2303
30	1278	1199	1406	1321
45	789	746	700	765



Question 4a (2 marks)

State a reason for having four students repeat the same experiment and **justify** your answer.



Question 4b (3 marks)

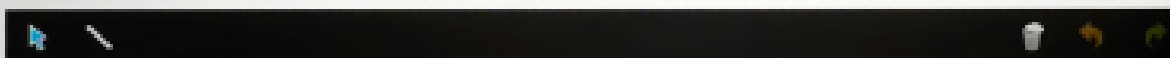
The class started to transform the data. Their transformed data is shown in the table below. Use the raw data above to **calculate** the missing values and complete the table.

Exposure time to UV radiation / minutes	Average concentration of CO ₂ after 3 minutes / ppm	Average rate of CO ₂ production / ppm min ⁻¹
0	2350	783
30		
45	750	250

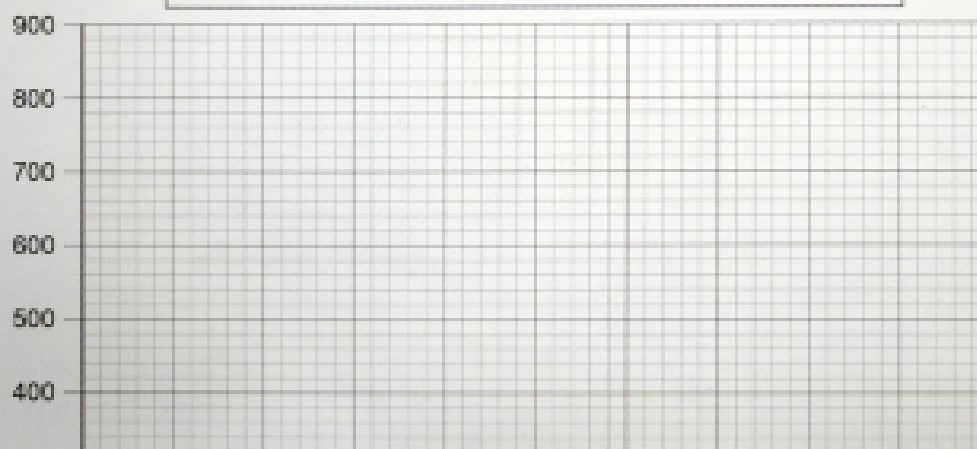


Question 4c (4 marks)

Plot the data in part (b) on the axes below. **Draw** a line of best fit and add labels for the axes.



The effect of UV radiation on the rate of respiration of yeast



Draggable:





Question 4d (1 mark)

Use the graph in part (c) to **predict** the average rate of CO_2 produced by yeast exposed to UV radiation for 20 minutes.

Rich text editor toolbar with icons for bold, italic, text color, background color, bulleted list, numbered list, link, unlink, undo, redo, and a styles dropdown menu.



Question 4e (2 marks)

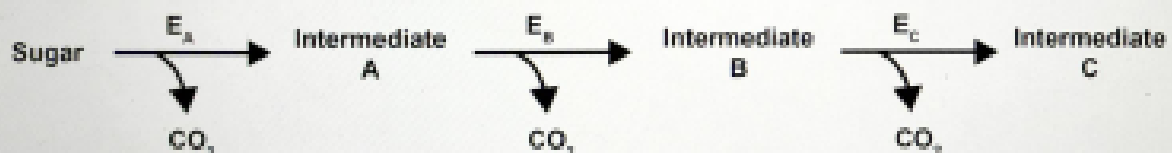
The class left the experiment to continue overnight. They noticed that the concentration of CO_2 was unchanged at 750 ppm.

Suggest two reasons why the concentration of CO_2 was unchanged.



Question 4f (2 marks)

A researcher wanted to investigate the reason behind the decrease in CO_2 production with exposure to UV radiation. To do this, he carried out some DNA studies on yeast. Below is some research he gathered about the steps involved in the transformation of sugar during respiration.



The enzyme needed for step 1, E_a , is produced from Gene A.

The enzyme needed for step 2, E_b , is produced from Gene B.

The enzyme needed for step 3, E_c , is produced from Gene C.

Outline the meaning of the term gene.



Question 4g (1 mark)

After exposing yeast to UV radiation for different lengths of time, the researcher did a genetic analysis on Gene A, Gene B and Gene C, the results of which are shown below:

Exposure time to UV radiation / minutes	Number of observed changes in yeast DNA		
	Gene A	Gene B	Gene C
0	0	0	0
30	2	2	2
45	5	3	2

Interpret the data in the table to suggest the relationship between UV radiation and the number of observed changes in yeast DNA.



Question 4h (3 marks)

The students' initial results are repeated in the table below:

Exposure time to UV radiation / minutes	Concentration of CO ₂ after 3 minutes / ppm			
	Student 1	Student 2	Student 3	Student 4
0	2201	2499	2397	2303
30	1278	1199	1406	1321
45	789	746	700	765

Using these results and the results from part (g), **suggest** an explanation for the effects of UV on the rate of respiration of yeast.



Question 4i (2 marks)

The class determined that the yeast was killed after 60 minutes of exposure to UV radiation. They proposed that UV radiation could be used to sanitize surfaces by killing microorganisms. Use evidence from this investigation and scientific reasoning to **suggest** if UV radiation would be effective in sanitizing surfaces.

B **I** **←** **→** **U** **x** **x'** **∑** **∑** **Ω** **Σ** Styles **+**



Question 5 (19 marks)

Design an investigation to test the effect of changing the temperature on the rate of respiration of yeast. You are provided with standard laboratory equipment. In your answer, you should include:

- the independent variable, dependent variable and two control variables
- a testable hypothesis
- equipment you will use
- details of how to manipulate, measure or monitor the variables
- details of the method used to collect sufficient data
- a justification of the range you will use for the independent variable.

B **I** **←** **→** **U** **x** **x'** **∑** **∑** **Ω** **Σ** Styles **+**



Question 6 (8 marks)

Rabies is a disease that affects mammals around the world. The video below gives some information about rabies.

Managing healthy populations of wild animals is different across the world. Animal populations can suffer from injuries and diseases. Over-population and unsustainable grazing can destroy habitats.

Healthy populations are monitored for reproduction rate and diseases.

One major disease affecting global populations of animals is rabies. Rabies is transmitted through the saliva of infected mammals, often through bite wounds. Rabies has been eradicated* in some countries, but as globalization and ecological disruption increase, many infectious diseases like rabies may re-emerge.

Rabies is an example of a disease that is able to move from one species of mammal to another, including humans. It is responsible for the death of approximately 59 000 people worldwide each year.

Cooperation is needed to reduce the spread of rabies among wild animals and to prevent the infection of humans and domestic animals.

Traditional strategies include the use of fences, vaccination and the killing of infected animals.

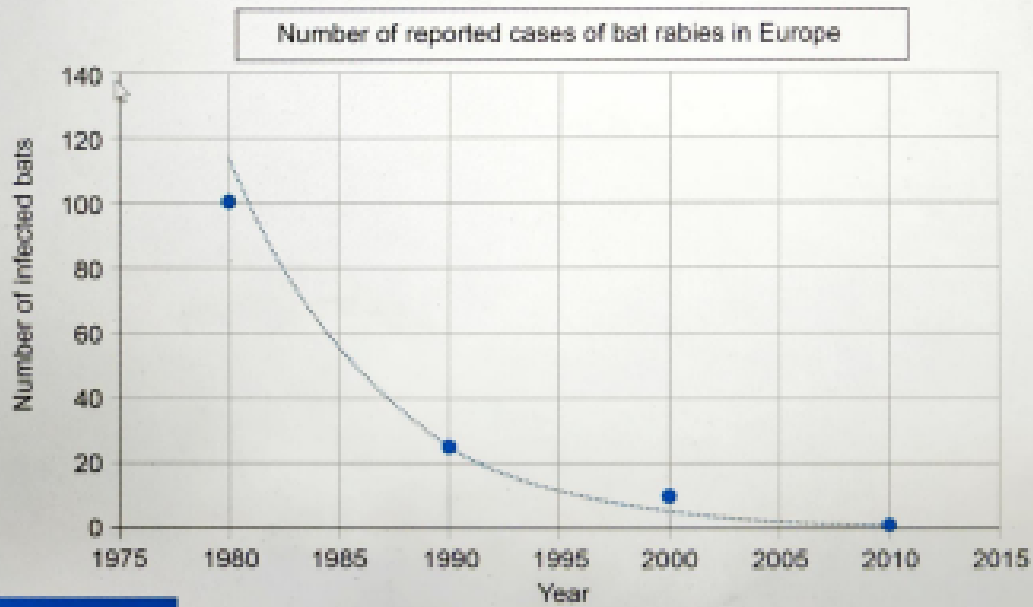
An ethical decision is needed to balance the advantages to human health with the potential consequences for ecosystems.

*eradicated: totally wiped out



Question 6a (1 mark)

The graph below shows the number of reported cases of bat rabies in Europe between 1980 and 2010.



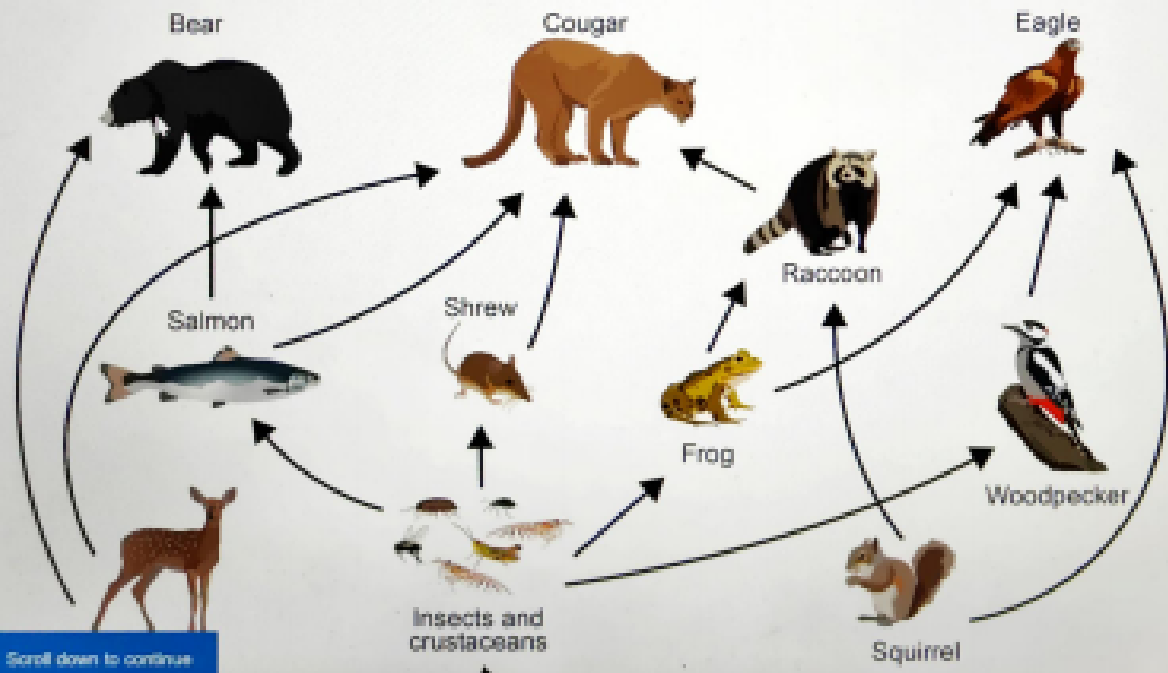
Use information from the video to **suggest** one human action that has led to a change in the number of cases of bat rabies in Europe.

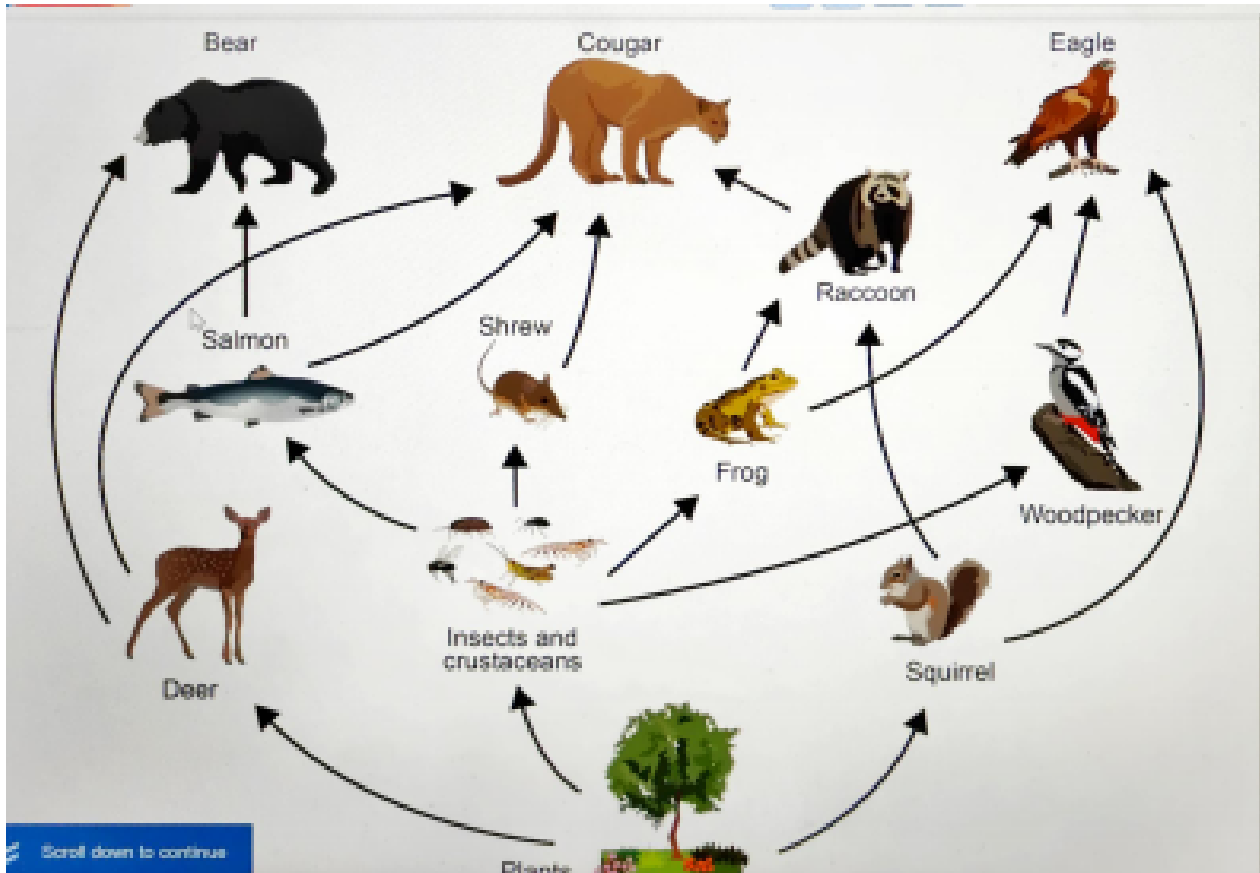
B *I* \pm \rightarrow \leftarrow $\sqrt{\quad}$ \times \div $\frac{\square}{\square}$ \int \sum Ω Σ Styles \cdot \square



Question 6b (2 marks)

The feeding relationships in an ecosystem are shown in the food web below.





Using the diagram, **identify** a food chain containing organisms that cannot be infected with rabies.

→ → →



Question 6c (5 marks)

Some raccoons in the ecosystem were infected with rabies. **Suggest** two possible consequences for other organisms present in the ecosystem. **Justify** your answers. You should use scientific language in your answer.



Consequence 1 and justification

B I | ← → | **U** \times \times' | **=** **≡** | **Ω** **Σ**

Styles -

Consequence 2 and justification

B I | ← → | **U** \times \times' | **=** **≡** | **Ω** **Σ**

Styles -



Question 7 (16 marks)



Question 7a (14 marks)

Rabies is a disease which affects people across borders and in different regions. 99 % of cases in humans occur as a result of bites from dogs infected with rabies. One strategy to eradicate rabies in humans is to vaccinate dogs and prevent transmission between these two species. People in different regions have a shared responsibility to work together to develop an effective global solution. The World Health Organization (WHO) has a target to eradicate rabies by 2030.



In many countries domestic dogs are vaccinated against rabies by veterinary nurses. However, in some areas, stray and wild dogs commonly live alongside humans where food waste is plentiful. In order to combat rabies, an oral vaccine could be added to food which is then left out for these stray and wild dogs. These vaccines could also include contraceptives.

Discuss and **evaluate** the use of an oral vaccine in preventing the transmission of rabies from infected stray and wild dogs to humans. In your answer, you should include:

- an advantage and a disadvantage of using an oral vaccine rather than an injectable vaccine, with justification
- a suggestion of why a contraceptive might be included with the rabies vaccine
- an outline of the ethical considerations of using oral vaccines in stray and wild dogs
- a discussion of why economic and political collaboration is needed to solve global issues
- a concluding statement.



Question 7b (2 marks)

An alternative strategy for preventing rabies in humans is to give an anti-rabies vaccine directly to children. **Suggest** an advantage and a disadvantage of vaccinating children against rabies.

Advantage

B *I* | + - | U *_n xⁿ | ¶ | Q Σ | Styles - |